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THE AMERICAN CHEMICAL  
SOCIETY

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

C. S. Brinton, *secretary*T. J. Bryan, *chairman*JOINT SYMPOSIUM WITH DIVISION OF BIOLOGICAL  
CHEMISTRYSubject: Edible Fats and Oils. Part A—Manu-  
facturing and TechnicalDavid Wesson, *chairman**Manufacture of edible fats and their com-  
pounds:* L. M. TOLMAN.

*Refining losses in the manufacture of edible oils:* B. H. THURMAN. Each step through the refining process will be discussed relative to various vegetable oils, cotton, peanut, soya bean and cocoanut. The action of refining materials in removing undesirable products and impurities is the largest source of shrinkage on most oils. Methods for determining the percentage of impurities, such as lecitho-proteins and coloring matter, will be given, both from laboratory and factory determinations. There are emulsions formed and broken, which are described in detail, giving some experiences of handling them in the factory. One that is not yet handled successfully and causes loss should be interesting to the colloidal chemist. Another step in the process illustrates selective absorption by Fuller's earth and carbon black. Losses due to volatility and solubility are accounted for with averages for different vegetable oils.

*Corn oil—its preparation and uses:* A. F. SIEVERS. Corn oil is produced as a by-product in the hominy and cornstarch industries. From eighty to one hundred million pounds are produced annually, of which about 70 per cent. is refined for food purposes. Corn oil is classed as a semi-drying oil but has poor drying qualities and therefore does not enter largely into the manufacture of paints. It is used in the manufacture of soap and in making its greatest progress for practically serving the same purposes as cottonseed and peanut oils. Its physical and chemical properties are similar to cottonseed and soya bean oils. The oil prepared from dry process germs is generally lighter in color and contains less free acid than that made from wet process germs.

*Edible fats in the baking industry:* CHARLES A. GLABAU. This paper is based on the data obtained in our laboratory which to us is quite interesting especially where the homogenizer has entered in. The paper bears the following subtitles: (1) Introductory; (2) defining the various

kinds of bakery products in which edible fats are used; (3) how the fats are introduced and incorporated; (4) why fats are added to bakery products; (5) the results obtained by adding graduated quantities of fat to bread doughs (stereopticon plates); (6) tracing the fat through the dough mass with coal tar derivatives (stereopticon plates); (7) introducing a new method of incorporating fat and mixing the dough; (8) the results obtained by homogenizing fats used in the bakery; (9) the distribution of emulsions through the dough mass; (10) determining the carbon dioxide diffused through doughs containing prepared emulsions and doughs in which the fats are incorporated in the general manner; (11) conclusion.

*The action of shortening in the light of the newer theories of surface phenomena:* WASHINGTON PLATT and R. S. FLEMING. The following definition of shortening and shortness is used: "Shortening is any fat or fixed oil used as an ingredient in baked products. That material has the greatest shortening power which, when baked in a dough under standard conditions, gives to the product a minimum breaking strength and a minimum crushing strength." A cookie is seen to be essentially a mass of gluten and starch, soaked in a concentrated sugar solution. Shortening is the only material in dough not soluble in water or wetted by it. Shortening brings about its effects by extending throughout this dough or cake in layers which separate the particles of the dough or cake from one another and prevent the formation of a continuous solid mass. When care is taken to prevent change of the specimen on mounting, the fat may be seen microscopically in the dough and cake, extending in films around the starch grains. An investigation was made to determine the cause of the difference between the shortening power of the common fats. Viscosity, surface tension *vs.* air and melting point considered alone are seen to be of minor importance. Plasticity is seen to be a more important factor. The work of Langmuir and of Harkins on phenomena at liquid interfaces is correlated with the differences in shortening power. The close connection between the action of shortenings and of lubricants is emphasized.

*Certain physical and chemical requirements of fats in the evaporated milk industry:* HARPER F. ZOLLER. The evaporation of milk in a vacuum pan at the temperature and pressure under factory operation necessitates the consideration of factors in connection with the constitution and physical make-up of fats which are uncommon in

all other industries in which fats are used. The fat should have an iodine absorption number below 30. It must contain a minimum of fatty acid esters which, when hydrolized, will yield fatty acids possessing unusual flavors or odors (*e. g.*, arachidic, theobromic, erucic, ricinoleic, etc.). Its "ethyl ester value" should be quite high, preferably, in the purified natural fat, above 12. The content of stearin and pulmitin should not be high enough to raise the melting point above 50° C. It should be a fat which is readily purified and should not therefore contain substance such as phytosterol, sitosterol, alkyl amines, etc. Happily enough, cocoanut oil and palm nut oil which are widely used in the margarine industry because of their availability and physical properties come closer to these requirements than do any of the commercial fats save butter fat. Inasmuch as the margarine industry used cocoanut oil it was but natural that the compound milk industry should choose it. From the standpoint of condensation in the vacuum pan in the presence of the milk, a good grade of cocoanut oil works more admirably than does butter fat itself. The same may be said of palm nut oil. The high iodine number of some butter fats, 28-42, renders it subject to slight rancidification (hydrolysis) in the vacuum pan and subsequent sterilization. Partially hydrogenated cotton oil may be used providing its iodine number is kept about 30, so that its melting point will not interfere with the pan process.

*The analytical detection of rancidity:* ROBERT H. KERR. The analytical tests used for the recognition of rancidity, the chemical and physical differences between rancid and sweet fats, and will give some consideration to the mechanism of rancidity and the changes involved in its development.

*Rancidity and a method for its detection:* H. C. BASHIOM and R. J. NOBLE. Rancidity of two types, "A" and "B"—"A due to volatile fatty acids, "B" due to volatile fatty acids and aldehydes. Rancidity "B" detected and comparatively estimated by means of Schiff's Reagent (pararosaniline acetate dissolved in dilute sulfurous acid solution). A 0.5-1.0 per cent. solution of the oil in kerosene or preferably benzene is shaken with an equal volume of the reagent in a separatory funnel, continuously or intermittently for 30 minutes. If the oil be rancid, a violet to blue coloration will appear immediately or within a few minutes in the benzene or kerosene layer. The color developed is proportional, within limits, to the degree of rancidity. The test is very delicate and especially suitable for

the detection of "B" in cereal products containing small amounts of oil.

*The oil, fat and wax laboratory, Bureau of Chemistry, Department of Agriculture, and its relation to the vegetable oil and fat industry:* GEORGE S. JAMIESON and WALTER F. BAUGHMAN. An account of the vegetable oil and fat investigations conducted by this laboratory, discussed under three heads: Olive oil and its substitutes, supply of fats and oils during the war and fundamental investigations. It is almost impossible to get adulterated olive oil past the barriers at our ports. The small amount of adulterated oil on the market is sophisticated in this country by small firms. During the war our imports of fats and oils exceeded our exports. The first complete survey of the fat and oil industry was made. It was not possible to increase production of cottonseed oil, but production and importation of peanut and soya bean oils were greatly increased. Many new possible sources of oil were investigated. The chemical composition of some of the vegetable oils have been determined. A representative number of authentic samples of cottonseed and peanut oils have been analyzed to establish the limits of variations in the chemical and physical characteristics of these two oils. A new method has been developed for determining the amount of neutral oil in crude oils. Work is in progress on the isolation and identification of all constituents of cottonseed oil and their effect on refining.

*Colorimetry as applied to the vegetable oil industry:* DAVID WESSON. Cottonseed oil has always been sold on color and various means have been devised from time to time for reading and recording color. Modern conditions have called for more accurate instruments than those used in the past, using Levibond Tintometer glasses. The Eastman Kodak colorimeter furnishes an ideal instrument for measuring and recording the color of samples where colorimetric measurements only are desired. Where it is necessary to analyze a color as in research work, the new Keuffel and Esser color analyzer is to be preferred.

*A brief note on the examination of the fat from Theobroma grandiflora:* W. C. TABOR.

*A rapid quantitative method for the determination of arachidic-lignoceric acid mixture in peanut oil:* ARTHUR W. THOMAS and CHAI-LAU YU.

*The chemical composition of sunflower seed oil:* GEORGE S. JAMIESON and WALTER F. BAUGHMAN. Sunflower seed oil is used in various foreign countries as a food oil and in making butter substitutes, soaps, varnishes and enamels. Several million pounds of the seed are produced annually

in the United States for poultry feed and the production could be greatly increased. The whole seed contains 27 per cent. to 30 per cent. oil and the kernels which constitute about 53 per cent. of the seed contain approximately 53 per cent. oil. It is a drying oil. S. G. 25/25 is 0.9193; refractive index 20°, 1.4736; iodine number (Hanus), 130.8; saponification number, 188.0; unsaponifiable matter, 1.2 per cent.; saturated acids, 7.1 per cent.; unsaturated acids, 86.6 per cent.; iodine number of unsaturated acids, 147.9. The oil consists of glycerides of the following acids: oleic, 33.4 per cent.; linolic, 57.5 per cent.; palmitic, 3.5 per cent.; stearic, 2.9 per cent.; arachidic, 0.6 per cent.; lignoceric, 0.4 per cent.

*The chemical composition of soya bean oil:* WALTER F. BAUGHMAN and GEORGE S. JAMIESON. The oil was pressed from mammoth yellow variety of soya beans by an expeller. Specific gravity, 25°/25°, .9203; refractive index 20°, 1.4736; iodine number (Hanus), 128.0; saponification value, 189.5; unsaponifiable matter, 0.6 per cent.; saturated acids, 11.5 per cent.; unsaturated acids, 83.5 per cent.; iodine number of unsaturated acids, 148.7. Bromine addition derivatives of unsaturated acids were made and analyzed. The methyl esters of saturated acids were fractionally distilled under diminished pressure and fractions analyzed. Oil was found to consist of glycerides of following acids: linolenic, 2.3 per cent.; linolic, 51.5 per cent.; oleic, 33.4 per cent.; palmitic, 6.8 per cent.; stearic, 4.4 per cent.; arachidic, 0.7 per cent.; lignoceric, 0.1 per cent.

*On the use of n-butyl alcohol in the determination of the titer test of fats and oils:* H. A. SCHUETTE and J. H. DRAIZE. A study was made of the effect of substituting n-butyl alcohol for glycerol or ethyl alcohol as a saponifying medium in the official methods for determining the solidifying point of the mixed fatty acids, or titer test, of fats and oils. Inasmuch as the melting point, iodine absorption number and titer test of the mixed fatty acids of a series of fats and oils were found to be substantially the same when sodium n-butoxide, glycerol potash or a hydro-alcoholic solution of sodium hydroxide were used as saponifying agents, it is concluded that the former may be substituted for the others without loss of accuracy. A complete and more rapid saponification, without seorching of the resulting soap, is possible.

*The fat soluble vitamin:* H. C. SHERMAN. This paper constitutes a review of present knowledge of the fat-soluble vitamin with special reference to recent advances and practical applications to some food problems. While the fat-soluble

vitamin has been studied mainly by means of experiments upon rats, it is now known to have very important functions in the nutrition of animals generally, including men. It is needed by adults as well as during growth. A food supply containing only enough of the fat-soluble vitamin for growth will not support full vigor. When the food furnishes too little of the fat-soluble vitamin the body is weakened and becomes more sensitive to infection. On the other hand the body is able to store this vitamin in cases in which the food furnishes more than is required for current needs. The vitamin should be reckoned with as an important factor in food values. The supplementary relationship between foods of high fuel value and those of high vitamin value is discussed.

*Color vs. vitamin content of fatty foods:* LEROY S. PALMER.

*Commercial vitamin preparations:* WASHINGTON PLATT.

*Thoroughness of digestion of different kinds of fats and oils:* C. F. LANGWORTHY.

*Studies of the vitamin potency of cod liver oils.* II. *The effect of season on the vitamin potency of cod liver oil—spring oil.* ARTHUR D. HOLMES. The present paper is one of a series reporting experiments undertaken to determine the vitamin "A" potency of cod liver oils obtained at different seasons of the year. To obtain oils of known origin the author personally obtained oils of cod livers from cod fish and rendered the oils under laboratory conditions. Attention is being given to other factors which vary during the year, such as physical condition, sexual activity and diet of fish. Tests with early spring oil from emaciated fish show that .00202 grams of oil daily is fully adequate for the vitamin "A" growth requirements of albino rats.

*The influence of light on the synthesis of vitamin A in sprouting white and yellow corn:* J. S. HUGHES and W. R. HORLACKER. A sample of yellow corn having a high vitamin A content and one of white corn having a low vitamin A content were sprouted both in the light and dark. The vitamin A content of the sprouts not including the grain was tested by the usual feeding test with rats. The sprouts from both the white and yellow corn grown in the light had a high vitamin A content. The sprouts from neither the white or yellow corn grown in the dark contained much of this vitamin. The results indicate that the vitamin A content of the seed has very little influence on the vitamin A content of the sprout, but that the sunlight is an important factor in the synthesis of vitamin A.

*Suggestions in technic vitamin work:* EDWARD

F. KOHMAN. We hear much about the destruction of vitamins by the action of heat and oxidation. Vitamin A is said to be especially sensitive to oxidation and vitamin C to both heat and oxidation. But with the exception of a very few instances, the experiments from which such conclusions are derived do not justify an assumption as to whether the destruction noted was really the result of heat or oxidation. No reference has been found in any experiments relating to the effect of heat and oxidation in which the oxygen content of the product or of the cooking water has been taken into account. Practically all fruits contain more or less atmospheric oxygen both in solution and mechanically trapped. To eliminate this a high vacuum is not sufficient unless the container is jarred by rather sharp blows. More important is the oxygen held in solution by the water used for cooking. This can not be removed with less than five minutes boiling, nor is a vacuum effective unless the container is jarred. For temperatures less than boiling, hours are required, and during this time the dissolved oxygen would be more available for oxidation of the vitamin than the oxygen of the air which is in contact with the surface. Air-free water dissolves air very readily and therefore must be kept out of contact with air until used.

*The chick as an experimental animal in vitamin studies.* II—*With respect to the fat-soluble vitamins:* A. D. EMMETT and GAIL PEACOCK. Continuing the study of comparing the chick with the rat and pigeon the findings relative to the fat-soluble vitamins indicate in the case of the White Leghorn breed that they are fairly suitable for test purposes. In marked contrast with the pigeon, the fat-soluble vitamin requirements of the chicken are very much greater. The most prominent symptoms are weak legs, partial paralysis, enlarged knee joints, dropping wings, weak eyes, accompanied by xerophthalmia which stimulates roup, diminished pigmentation of comb, bill, legs and feet, labored breathing, poor oxidation and loss in weight. In other words, the chick (male or female) needs both the antirachitic and the antiophthalmic fat-soluble vitamins, while the pigeon appears to need relatively little of either. A lack in these requirements is apparently more markedly evidenced in chicks three to four weeks old than in those that are six to nine weeks old. In fact, the onset of the symptoms are so rapid in the younger animals that it is very difficult to bring about a correction of the ailments before death ensues. For practical test purposes our

data, which includes some 600 birds, suggest that chicks about seven weeks old are the most suitable. Compared with the rat, the chick has its limitations as a test animal. It occupies more space, consumes more food, has a greater range of variation in rate of growth, being more difficult to handle and bring through the early and critical period of growth.

*Milk and ice cream as fatty foods:* JEROME ALEXANDER. Since milk contains 88 per cent. of water, the legal 3 per cent. fat means 25 per cent. of the total solids, so that milk is a fatty food. When the casein coagulates it mechanically entraps the fat, thus forming a greasy curd which is hard to digest. Cows' milk has a low protective ratio, *i. e.*, the ratio of casein to lactalbumin, and therefore readily forms greasy curds unsuitable for the human stomach. Increasing the protective ratio by adding any colloidal protector (gelatin, eggs, etc.) prevents this difficulty, and is of especial importance in ice cream, where the fat content is much higher than in milk. The effect of colloidal protection in artificial milks and cheese is still to be worked out.

*A new method for the determination of vanillin:* H. C. BASHIOUM and FRED Y. HERRON. This method depends upon the properties of the aldehyde group rather than those of the phenolic group as is usually the case. In practice, the solution containing vanillin is saturated with hydrogen sulfide in the presence of hydrochloric acid, whereupon a white precipitate of thiovanillin is produced. The precipitate is filtered off, washed with water and then dissolved in dilute sodium hydroxide solution in which it easily dissolves, producing a yellow color, the intensity of which is proportional, within limits, to the concentration of thiovanillin.

*The soda equivalent of sour milk used in baking:* MARY P. WILSON and H. A. WEBB. Baking soda and sour milk can not be titrated together with any known indicator. A method of preparing alizarine test paper of approximately N/20 strength (one No. 3 quinine capsule of soda in  $\frac{1}{4}$  standard cupful of water), drying and "spotting" with mixtures of the N/20 soda, measured in drops, and  $\frac{1}{4}$  teaspoon of the sour milk under examination, was worked out. When the spot shows no color change, the number of spots made permit calculation of the equivalent amounts of baking soda or baking powder per cup of milk of any degree of acidity.

CHARLES L. PARSONS,  
*Secretary.*